Air Quality Monitoring Station
Performance Audit
For
Behr Iron & Metal

October 5th, 2016

Shell Engineering
& Associates, Inc.

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October 21, 2016

Mr. Andrew Setter
Behr Iron & Metal
1100 Seminary Street
P.O. Box 740
Rockford, IL 61105

RE: Quality Assurance Audit for Ambient Lead TSP Hi-Vol, Wind Speed, Direction, Temperature and Pressure.

Dear Mr. Setter:

Please find enclosed the quality assurance audit results for the audit conducted on October 5, 2016, at the Behr Iron & Metal facility in Rockford, IL. The audit assessed the accuracy of the TSP/Pb sampler and the meteorological parameters of wind speed, direction, temperature and pressure.

Appendix A provides audit data printouts and Appendix B provides audit equipment certifications. Please see the Recommendations and Comments section of this report for specific information regarding each item that was audited.

Thank you for allowing Shell Engineering & Associates, Inc. to conduct this audit. Please let me know if you have any questions or comments.

Sincerely,
Shell Engineering & Associates, Inc.

Joseph W. Grosvenor
Joseph W. Grosvenor
Senior Monitoring Specialist

Audit Introduction

On October 5, 2016 Joe Grosvenor of Shell Engineering & Associates, Inc. conducted a quality assurance audit of Behr Iron and Metal's ambient air monitoring site located in Rockford, IL. Andrew Setter and Patrick Kohlmeier represented Behr Iron & Metal and Darina Demirev with RK & Associates was also present. The audit was conducted in accordance with the guidance procedures of the U.S. EPA *Quality Assurance Handbook for Air Pollution Measurement Systems:*

Volume II, EPA-454/B-13-003,

Volume IV, EPA-454/B-08-02,

Tisch Environmental, VFC+ Operator's Manual, Version 6

The QA audit assessed the accuracy of the High Volume TSP/Pb sampler flows, and the accuracy of the meteorological system in measuring the parameters of wind speed, wind direction, temperature and pressure.

This report is divided into sections that describe the audit equipment, procedures used, results of the audit, and comments and recommended actions. Appendix A provides the audit data of each parameter and Appendix B provides the certifications of the audit test equipment.

Description of Audit Equipment

The ***TSP/Pb*** particulate sampler flows were audited using a variable flow calibration orifice, which was last certified by the Tish Environmental Services on July 11, 2016.

The ***TSP/Pb*** particulate sampler temperature and pressure sensors were audited using a Streamline Pro Multi Cal which was last certified by Chinook Engineering on March 21, 2016.

The ***Wind Speed*** audit was performed using a RM Young Model 18801 Variable Speed Anemometer Drive that rotates the wind speed shaft at known RPM speeds. It was last certified on February 25, 2016 by the Indiana Department of Environmental Management.

The ***Wind Direction*** audit was performed using a Brunton compass to determine the angle of the cross arm and then the vane was turned and held in the four 90° positions in reference to the cross arm.

The ***Meteorological System*** temperature and pressure sensors were audited using a Streamline Pro Multi Cal which was last certified by Chinook Engineering on March 21, 2016.

Audit Procedures

The **TSP/Pb** sampler QA audit was performed by first installing Shell Engineering's certified adjustable orifice in place of the filter on the sampler. A short water manometer was attached to the fully open orifice and the sampler was allowed to run for several minutes to allow it to warm up and stabilize the flow.

After the warm up period the site pressure and temperature data were obtained from NIST traceable sensors that were certified within the last 12 months. This data was compared to the sampler site pressure and temperature data. Readings from both systems were then recorded onto the data sheet and entered into the computer for calculating the airflow corrections.

The next step is to obtain the orifice manometer reading and record it on the data sheet and enter it into the spreadsheet. The flow from the sampler's High Vol+ system was also recorded on the data sheet and entered into the spreadsheet. The sampler flow from the Shell Engineering's orifice manometer reading was then compared to the TSP/Pb sampler indicated flow in actual conditions. Percent differences were figured for actual and standard conditions.

This information was entered into the computer spreadsheet to calculate the percent error.

The ***Wind Speed*** system response was audited by introducing zero and five constant rates of rotation within the normal operating range of the sensor. The certified rates of rotation were converted to a wind speed based on the manufacture supplied transfer coefficients. The response was read from the data logger output.

The ***Wind Direction*** audit was performed by determining the direction of the mounting cross arm using a surveyor's compass. The magnetic measurements were corrected for magnetic deviation. The response of the wind direction system was then audited by rotating the vane in a clockwise rotation and taking readings from the data logger at every 90° setting.

The ***Temperature*** on the meteorological system was audited by collocating a NIST traceable sensor

next to the tower sensor and comparing the temperature sensor response from the data logger to the output on the traceable sensor.

The ***Pressure*** on the meteorological system was audited by collocating a NIST traceable sensor next to the tower sensor and comparing the sensor response from the data logger to the output on the traceable sensor.

Audit Results (See Appendix A)

Recommendations and Comments

The TSP/Pb High Volume sampler responded very well during the audit. The flow, temperature and pressure were all within EPA allowable limits.

The meteorological system sensors appear to be functioning as designed except for the following issues.

Before the wind direction audit, the wind direction mounting cross arm was checked with a Brunton surveyor's compass to determine its orientation. It appeared that the orientation of the cross arm was at 112-292 degrees. The compass was moved 180 degrees to the other side of the tower so another reading could be obtained. This reading varied from the first by approximately 10 degrees. The second reading was obtained in close proximity to the chain link fence that is next to the site, so magnetic interference may be a problem. Since there were varying results with the surveyor's compass it is recommended that another method be employed to determine the true orientation of the mounting cross arm. One method is the solar method which is described in section 2.5.2.3 of *Volume IV,EPA-454/B-08-02, Meteorological Measurements.*

The audit was performed using the initial orientation of 112-292 degrees as shown in the audit results of the wind direction. The wind direction sensor responded well when being rotated at 90 degree intervals showing that it is functioning properly. The orientation needs corrected either physically or in the data acquisition system. Overall, the sensor output (including 3 degrees west declination) was estimated to be 160 degrees off.

A calibration is recommended on the pressure sensor on the meteorological tower because it exceeded the allowable criteria when compared to the NIST traceable sensor. The manufacturer recommends recalibration every two years under normal use and every year in areas where a lot of contaminants are present.

Appendix A

Audit Data

Hi-Volume Sampler Audit
Shell Engineering & Associates, Inc.
Quality Assurance Program

Volumetric Flow Controller
(VFC+)

Date : October 5, 2016

Site		Calibration Orifice	
Company :	Behr Iron & Metal	Make/Model :	BGI
Location :	Rockport, IL	Serial :	584N
Site ID # :	201030AYB	Cert. Date :	July 11, 2016
Serial # :	P10017 TSP VFC	Slope :	1.000550
		Intercept :	-0.014300

Standard used:	Streamline C081205	Instrument Response:	
Ta (deg C)	25.1	Ta (deg C)	24.5
Ta (deg K)	298.3	Ta (deg K)	297.7
Pa (mm Hg)	740	Pa (mm Hg)	740

	Orifice			Sampler				
Point Number	Inches H20	Actual m3/min	Standard m3/min	Actual ft3/min	Actual m3/min	Standard m3/min	Actual % Diff	Standard % Diff
1	3.9	1.267	1.234	45.4	1.286	1.254	1.44	1.64
					Limits (±)		7%	7%

Notes:

Station Rep : A. Setter/P. Kohlmeier **Auditor :** Joe Grosvenor

Calculations

Calibrator Orfice Flow Value (Qa) = 1/Slope*(SQRT(H20*(Ta/Pa))-Intercept)

Qstd = Qa * (Pa/760) * (298.15/Ta)

% Difference = (Look Up Flow-Calibrator Flow)/Calibrator Flow*100

Meteorological Audit

Shell Engineering & Associates, Inc.

Location:	Behr Iron and Metal, Rockford, IL	**Date:**	October 5, 2016
ID:	201030AYB	**Last Calibration :**	Factory

Equipment Used

Direction:	Brunton Transit	**Speed:**	R.M. Young CA01580
Temperature	Streamline C081205	**Pressure:**	Streamline

Instrument Data

Manufacturer - -	R M Young/ Campbell	**Serial Numbers - -**	Wind 139946
Models - -	05103/PTB110/Therm107	**Barometer Range**	500-1100 mbar
Primary Recording - -	Campbell CR6	**WD Range - -** 0 to 360°	**WS Range --** 0 to 220 mph
Backup Recording - -	USB memory stick	**Temperature Range - -**	-35 to +50 degrees C

Site Magnetic Variation from True North: 3° West **Direction Reference:** 112/292

Audit Setting	Wind Direction Clockwise Rotation				Wind Direction Design Mechanical Responses		
	Setting	Degree	Difference		90° Setting	Degree	Difference
1	109	267	158		270	267	-2
2	199	360	161		360	360	0
3	289	88	159		90	88	-2
4	19	176	157		180	176	-4

Accuracy Limits - - +/- 5 degrees

Wind Speed Input			Wind Speed Response			
RPM		MPH		MPH	RM Young Limits	Pass/Fail
0		0.00		0.01	-0.55/0.55	Pass
600		6.58		6.58	6.08 / 7.08	Pass
1200		13.15		13.15	12.49 / 13.81	Pass
2000		21.92		21.92	20.82 / 23.02	Pass
4000		43.84		43.84	41.65 / 46.03	Pass
6000		65.76		65.76	62.47 / 69.05	Pass

Accuracy Limits - - ± 0.2 ms

Audit MPH = RPM * 0.01096

Temperature Input			Temperature Response			Accuracy
	°F	°C	°F	°C	Diff °C	Limits
Ambient	68.70	20.39	66.84	19.36	-1.03	± 2°C

Accuracy Limits - - ± 2°C when used for particulate analysis

Barometer Input(mmHg)			Barometer Response(mmHg)			
	740.0			760.0	20.0	± 10 mmHg

Accuracy Limits - - ± 10 mmHg when used for particulate analysis

Auditor : J. Grosvenor **Site Operator:** Andrew Setter, Patrick Kohlmeier

Comments: The wind direction readings above responded well mechanically when challenged in the four cardinal directions as it was designed to do but the orientation is off an estimated 160 degrees.
The barometric pressure sensor needs to be adjusted/recalibrated.

Appendix B

Certification of
Audit Test Equipment

TISCH Environmental

Shawnee Instruments
607 Laurelwood Dr.
Cleves, Ohio 45002
513-467-9825

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5028A

Date - Jul 11, 2016 Rootsmeter S/N 0438320 Ta (K) - 297
Operator Tisch Orifice I.D. - 584N Pa (mm) - 753.11

PLATE OR VDC #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORFICE DIFF H2O (in.)
1	NA	NA	1.00	1.2630	4.5	1.50
2	NA	NA	1.00	0.9830	7.3	2.50
3	NA	NA	1.00	0.9000	8.8	3.00
4	NA	NA	1.00	0.8340	10.1	3.50
5	NA	NA	1.00	0.6280	17.4	6.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)		Va	(x axis) Qa	(y axis)
0.9883	0.7825	1.2212		0.9940	0.7870	0.7691
0.9846	1.0016	1.5766		0.9903	1.0074	0.9929
0.9826	1.0918	1.7271		0.9883	1.0981	1.0877
0.9809	1.1762	1.8655		0.9866	1.1829	1.1749
0.9713	1.5467	2.4425		0.9769	1.5556	1.5382
Qstd slope (m) =		1.59785		Qa slope (m) =		1.00055
intercept (b) =		-0.02271		intercept (b) =		-0.01430
coefficient (r) =		0.99977		coefficient (r) =		0.99977
y axis = SQRT[H2O(Pa/760)(298/Ta)]				y axis = SQRT[H2O(Ta/Pa)]		

CALCULATIONS

Vstd = Diff. Vol[(Pa-Diff. Hg)/760](298/Ta)
Qstd = Vstd/Time

Va = Diff Vol [(Pa-Diff Hg)/Pa]
Qa = Va/Time

For subsequent flow rate calculations:

Qstd = 1/m{[SQRT(H2O(Pa/760)(298/Ta))]- b}
Qa = 1/m{[SQRT H2O(Ta/Pa)]- b}

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a division of Inter-Mountain Laboratories, Inc. — 555 Absaraka Street, Sheridan, WY 82801 USA

Certificate of Calibration

This Streamline Pro™ MultiCal™ System, serial number: **S081205**
was calibrated against the following NIST-traceable Reference Standards:
Flow: Critical Flow Venturi S/Ns 10962, 10963 — on date: 04/20/16
Barometric Pressure: Precision Barometer S/N 913930-M1 — on date: 03/21/16
Temperature: NIST Traceable Hg-in-glass thermometers, S/Ns 2J3106, 2Y6027, 3L9452. — on date: 03/21/16

Quality Assurance:

Flow:

Reference Std. Q_{ref} (l/min)	Streamline Pro Q_{SLPro} (l/min)	Absolute difference (l/min)	% Diff. F.S.
2.00	2.00	0.00	0.00%
5.00	5.01	0.00	0.02%
6.67	6.66	-0.01	-0.05%
10.00	10.02	0.01	0.06%
13.67	13.66	-0.01	-0.05%
16.67	16.68	0.00	0.02%
20.00	20.00	0.00	0.00%

BP:

Reference Std. BP_{ref} (atm)	Streamline Pro BP_{SLPro} (atm)	Absolute difference (atm)	% Diff. F.S.
0.750	0.750	0.000	0.03%
0.900	0.900	0.000	-0.02%
1.050	1.050	0.000	0.00%

Temp.:

Reference Std. T_{ref} (°C)	Streamline Pro T_{SLPro} (°C)	Absolute difference (°C)	% Diff. F.S.*
0.0	0.0	0.0	0.00%
21.6	21.6	0.0	-0.01%
43.4	43.4	0.0	0.00%

* based on absolute temp. scale (K)

Lab temp: 22.6 °C — Lab pressure: 0.870 atm

Certified By: Roger Sanders — Date: Apr 20, 2016

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Certificate of Accuracy

Transfer Standard Type: Streamline Pro™ External Temperature Probe

This Streamline Pro™ MultiCal™ System External Temperature Probe,

Model No. SLPRT203, SERIAL NUMBER: T081205

Was compared to:
NIST Traceable Hg-in-glass thermometers, serial numbers 2J3106, 2Y6027, 3L9452, and ice point. Miller & Weber Hg-in-glass thermometer S/Ns 2J3106 and 2Y6027 are traceable to NIST Test No. 209621, Test Method ASTME E-77. 2J3106 is traceable through Standard No. 1S1262. 2Y6027 is traceable through Standard No. 9C8072. Miller & Weber Hg-in-glass themometer S/N 3L9452 is traceable to NIST thermometer 40350, through Transfer Standards 3C4465 & 1Y9716.

Date: **March 21, 2016**

Lab temperature: 23.8 °C
Barometric Pressure: 655.7 mmHg

Reference Standard (°C)	Transfer Standard (°C)	Difference from Reference (°C)	Transfer Standard Correction* (°C)
0.0	0.0	0.0	0.0
21.8	21.8	0.0	0.0
43.5	43.5	0.0	0.0

Note: If no sign is given on the correction, the true temperature is higher than the indicated temperature. If the sign is negative, the true temperature is lower than the indicated temperature.

Certified By:  Date: March 21, 2016

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INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR QUALITY

CERTIFICATION OF
SELECTABLE SPEED ANEMOMETER DRIVE

Cert Type	Agency	Cert Date	Recert Date	Performed By
99	SHELL ENGINEERING	25-FEB-2016	25-FEB-2017	MBURKS

Certified By

Company

Transfer Std SN	Brand	Model
CAO1580	YOUNG	18801

Description/Comments

Send Date to Factory

Return Date to IDEM

Recert Freq 12 months

200	200	200	200	200	200	200	200	
2000	2000	2000	2000	2000	2000	2000	2000	
4000	4000	4000	4000	4000	4000	4001	4000	
6001	6000	6002	6000	6001	6000	6001	6000	
8002	8000	8002	8000	8002	8000	8002	8000	
9702	9700	9702	9700	9701	9700	9702	9700	

Comments

PERFORMED WITH AC POWER, BATTERIES DIDN'T WORK.